

Appl. No. 09/972,200
In re Kunieda et al.
Reply to Office Action of Sept. 10, 2004

Amendments to the Drawings:

The attached sheets of drawings include changes to Figs. 1, 3, 5, 6, 8, 9, 11 and 13. These sheets, which include Figs. 1, 3, 5, 6, 8, 9, 11 and 13, replace the original sheets including Figs. 1, 3, 5, 6, 8, 9, 11 and 13. In Figs. 1, 3, 5, 6, 8, 9, 11 and 13 minor errors have been corrected.

Attachment: Replacement Sheets

REMARKS/ARGUMENTS

The Examiner is thanked for the Official Action dated September 10, 2004. This amendment is intended to be fully responsive thereto.

The drawing figures 1, 3, 5, 6, 8, 9, 11 and 13 were objected to because of minor errors. The drawing figures 1, 3, 5, 6, 8, 9, 11 and 13 have been corrected to overcome these objections. No new matter has been added.

The Examiner further objected to figure 8, items (b) and (d) as not showing minutiae. Applicant respectfully disagrees. As described in the specification (see page 3, lines 17-20), "minutia is a special point on a ridge of fingerprints, whether the ridge is terminated at the point or ridge is bifurcated at the point." Clearly, Fig. 8(b) shows the fingerprint ridge including a point where the ridge is bifurcated (a bifurcation minutia), while Fig. 8(d) shows the fingerprint ridge including a point where the ridge is terminated (an ending minutia).

The Examiner objected the specification for failing to include descriptive title and for a numerous semantic and grammatical errors, inconsistencies and ambiguous language of the original specification and claims.

Furthermore, the Examiner objected to the last paragraph on page 11 as incomprehensible. The Examiner erroneously interpreted this portion of the specification as implying that "if there is a displacement between two fingerprint images, say A and B (image A, having minutia.(Xa, Ya), and Image B, having minutia (Xb, Yb», then they are similar. Yet, when this displacement is small, image A and image B are dissimilar."

In fact, the last paragraph on page 11 explains the process of comparing two fingerprint images. According to the disclosure, if the value of similarity function between two minutiae is large (i.e. the two minutiae of two fingerprint images are quite similar), then one of the two fingerprint images would very possibly be shifted along the vector $(X_b - X_a, Y_b - Y_a)$ to match the other of the two fingerprint images. On the other hand, if the value of similarity function between two minutiae is small (i.e. the two minutiae of two fingerprint images are not similar), then the two fingerprint images would not be shifted to match each other.

The Examiner also noted that the following sentence (page 12, lines 32-34 of the Applicant's original specification) is vacuous: "To compensate displacement due to rotation, all the minutia of input fingerprint image are compensated for rotation". However, the specification further explains that "the 2-dimensional coordinates or position of minutia are compensated by rotation around a standard origin point with a certain angle. Among information for minutia ridge shape, directional angle of minutia is also compensated to the same extent. However, compensation is not necessary for curvatures of minutia ridges because they are invariant against rotation. After compensating all minutia ridge shapes with the angle, the method without compensation of shifting is applied to do matching between two fingerprint images."

Applicant has attached hereto a substitute specification accompanied by a marked up copy showing the changes made to the original specification. The enclosed substitute specification includes amendments to correct minor informalities including comprehensive review and revision of the Applicant's original specification. Applicant submits that the

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substitute specification contains no new matter.

Claims 5, 8 and 10 were objected to for minor informalities. Claims 5, 8 and 10 have been amended to overcome these objections. No new matter has been added.

Claim 9 was objected to for as being of improper dependent form for failing to further limit the subject matter of the previous claim. Claim 9 has been canceled and new claim 17 reciting the limitations of the canceled claim 9 and properly depended upon claim 10 has been added.

Claims 1-16 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 1, 2, 4-8, 10-13 and 16 have been amended to address the Examiner's comments and rejections. No new matter has been added. Claim 9 has been canceled.

Claim 1, 2, 10 and 12 were rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. Claims 1, 2, 10 and 12 have been amended to address the Examiner's comments and rejections. No new matter has been added.

Further regarding claim 2: the Examiner erroneously noted that a curve is one-dimensional. One-dimensional is defined by something having one dimension, such as a straight line parallel to one of the orthogonal axes. Contrary to the Examiner's allegations, the curve is two-dimensional as each point on the curve is determined by two varying coordinates: x and y . Clearly, the curve cannot be represented by only one coordinate, thus it cannot be defined as one-dimensional.

Furthermore, the Examiner erroneously alleges that Applicant means an array of pixels that would constitute an image of the fingerprint. In fact, the specification clearly describes that the grid is comprised by a certain number of the pixels, and that the pixels are placed regularly with a certain period over the rectangular grid. In other words, not all the pixels in the grid constitute the image of the fingerprint.

Further regarding claim 12: the Examiner alleges that Applicant does not specify how the thinning, improvement, compensation, binarization, collection, and matching would be expressed by 40 or 60 bytes, in a way that would enable one of ordinary skill in the art. The Examiner is of opinion that 40 or 60 bytes represents a very small amount of data and that a fingerprint, with its complex ridge structure, cannot be expressed using only 40 or 60 bytes. Thus, the Examiner believes that the specification does not adequately enable one of ordinary skill in the art to implement the claimed invention. Applicant respectfully disagrees.

The present invention uses relative measures, such as the length of the chords between the adjacent measure points, distributed in small ranges so that smaller number of bits can be assigned. The table 1 below shows the Chord length, their binary expression and error in the present invention, where the chord length between the adjacent measure points is assumed to be constant and equal to 1 unit length.

Table 1

Chord Length	Binary (3 bits)	Precision Error (%)
1.800	000	0.0
1.970	110	-0.1
1.986	110	-0.9
1.864	010	-0.4
1.975	110	-0.3
1.996	111	0.1
1.997	111	0.0

As could be seen in the table 1 above, the curve recognition system of the present invention uses only 3 bites to express the arc length.

The table 2 below shows the Chord length, their binary expression and error in the prior art system of Jain et al. (USPN 6,487,306) cited by the Examiner.

Table 2

Euclidean Distance Length (d_i)	Binary (5 bits)	Precision Error (%)
1.0	00101	-6.3
1.7	01001	-0.7
2.4	01101	1.6
3.1	10000	-3.2
3.2	10001	-0.4
3.7	10011	-3.7
4.4	11000	2.3
5.1	11011	-0.7

As could be seen in the table 2 above, the curve recognition system of the prior art uses 5 bites to express the distance length. The precision error of the prior art system is up to 6.3%, while the precision error of the present invention is substantially lower. Such an arrangement extracts the features of fingerprints with minimum size of data, thus allowing a sequence of processing including thinning, compensation, binarization, thinning, collection and matching of fingerprint feature data to be expressed by 40 or 60 bytes of data.

Claims 1, 4, 11 and 16 were rejected under 35 U.S.C. 102(e) as being anticipated by Jain et al. (USPN 6,487,306). The applicant respectfully disagrees.

Anticipation under Section 102 requires that a prior art reference disclose every claim element of the claimed invention. *E.g., Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1574, 1 U.S.P.Q.2d 1081 (Fed. Cir. 1986). The absence of any element of the claim

from the cited reference negates anticipation. *E.g., Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 715, 223 U.S.P.Q. 1264 (Fed. Cir. 1984).

Regarding claim 1: Jain fails to disclose the curve recognition system using a sequence of several measure points placed on the fingerprint ridge so that chords connecting the adjacent measure points are of equal length. Unlike the present invention as recited in claim 1, Jain uses a plurality of ridge points p_i dividing a segment 830I (input ridge segment) of the reference input ridge into L subsegments (or arcs, not chords) of equal length. As clearly seen in Fig. 8B of Jain, lengths of the chords between the adjacent ridge points p_i are different.

By contrast, in the present invention as recited in claim 1 the shape of the fingerprint ridge is approximated by chords connecting the adjacent measure points. The measure points are selected so that the chords connecting the adjacent measure points are of equal length.

Furthermore, Jain fails to characterize the shape of the fingerprint ridge by data of lengths of chords between a starting measure point and an ending measure point for every 3 consecutive measure points on the ridge. As clearly seen in Fig. 8B, Jain uses the ordered sequence of the L successive Euclidean distances d_1 841, d_2 842, \dots , d_L 843 from the origin 810 to the respective ridge points p_1 821, p_2 822, \dots , p_L 820 for a one-dimensional discrete representation of the ridge segment 830.

Therefore, the present invention as recited in claim 1 significantly differs from the method of Jain. Thus, the rejection of claim 1 under 35 U.S.C. 102(e) is improper.

In addition to the above arguments regarding the patentability of claim 1, claims 4, 11 and 16 recite further limitations defining the present invention over Jain. Therefore, claims 4, 11 and 16 are in condition for allowance.

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Further regarding claim 4: in addition to the above arguments regarding the rejection of claim 1, Jain fails to disclose the system utilizing as an additional feature of fingerprints, both the minutia ridge shape and a ridge shape of a secondary minutia.

Jain employs the ridge information associated with the input and template minutiae set in the alignment estimation process. By contrast, the present invention as recited in claim 4 uses the secondary minutia generated from the original minutia in order to create simulated minutia on the fingerprint ridges.

Claims 8, and 12-14 were rejected under 35 U.S.C. 103(a) as being unpatentable over Jain. Claims 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jain in view of Sparrow (U.S. Patent 4,817,183). Claims 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jain in view of Yamaguchi et al. (U.S. Patent 6,314,196). Claims 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jain in view of Kamei et al. (U.S. Patent 5,974,163). Claims 7 and 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jain in view of Bergenek et al. (U.S. Patent 6,241,288). Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jain in view of Setlak et al. (U.S. Patent 5,828,773). The applicant respectfully disagrees.

Regarding claim 8: Contrary to the Examiner's allegations, Jain fails to disclose the means for employing two-dimensional array of memory areas for judgment; means for calculating a similarity measure for each pair of minutia data between input fingerprint image and registered template fingerprint; means for accumulating the similarity measure, wherein the similarity measure is stored in the memory area corresponding to that of a vector between the positions of the two minutiae; and means for judging input fingerprint as the same

registered one if a maximum value in the memory area exceeds a specified value.

The Examiner erroneously interpreted the pixels constituting an image as the memory areas. The Examiner also mistakenly noted that “the matching score accumulates the number of matching or corresponding minutiae among the input and template fingerprint -string representations (e.g. Jain column 8, lines 44-2).” Contrary to the Examiner’s allegations, the Jain in column 8, lines 44-2 simply states that “The Representer 630 converts the transformed template T' pattern and transformed input pattern I' into the polar coordinate representations with respect to the reference points/minutiae; and then subsequently represent them as two symbolic string representations, P and Q of the input and template fingerprints”, without disclosing any means for accumulating the similarity measure.

The Examiner further concedes that Jain do not show or suggest storing the similarity measure in a memory location corresponding to that of the vector between the positions of the pair of minutiae.

Nevertheless, the Examiner alleges that it would have been obvious to a person of ordinary skill in the art to store the similarity measure in a memory location corresponding to that of the vector between the positions of the pair of minutiae.

The Examiner’s allegation is unsupported by the applied prior art and inconsistent with the disclosure of Jain. In order to even establish a prima facie case of obviousness, the Examiner must identify each limitation in the prior art and the associated motivation to support the resultant modification. MPEP 2143. The Examiner failed to establish a prima facie case of obviousness. Applicant submits that the prior art fails to disclose the recited claimed limitations of claim 8.

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Moreover, the Examiner's assertion that Jain may be modified to achieve the limitations of the present invention as recited in claim 8 would clearly result from **hindsight reconstruction**, which is not permitted. MPEP 2143.01 specifically states that the mere fact that references can be combined does not render the resultant combination obvious unless the references suggest the desirability of the combination, citing *In Re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). There is no suggestion or motivation to support the Examiner's assertion.

Regarding claim 9: claim 9 has been canceled, thus rendering this rejection moot.

Regarding claims 2, 3, 5, 7, 10, 12, 13, 14 and 15: in addition to the above arguments regarding the patentability of claim 1, claims 2, 3, 5, 7, 10, 12, 13, 14 and 15 recite further limitations defining the present invention over the prior art. Therefore, claims 2, 3, 5, 7, 10, 12, 13, 14 and 15 are in condition for allowance.

Claim 6 was objected to as being dependent upon a rejected base claim. However, the Examiner noted that claim 6 would be allowable if rewritten in independent form to include all of the limitations of the base claim 1 and to overcome the U.S.C. § 112(1) and U.S.C. § 112(2) rejections stated above. Claim 6 depends upon the base claim 1 which, as argued above, defines the invention over the prior art. Therefore, claim 26 is in condition for allowance.

New claim 17 reciting the limitations of the canceled claim 9 and depended upon claim 10 has been added.

Therefore, it is respectfully submitted that claims 1-8, 10-13, 16 and new claim 17 define the invention over the prior art of record and are in condition for allowance, and notice

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to that effect is earnestly solicited. Should the Examiner believe further discussion regarding the above claim language would expedite prosecution they are invited to contact the undersigned at the number listed below.

Respectfully submitted:
Liniak, Berenato & White

By: 

Matthew W. Stavish
Reg. No. 36,286 / 41096

6550 Rock Spring Drive, Suite 240
Bethesda, Maryland 20817
Tel. (301) 896-0600
Fax (301) 896-0607

Attachments